spring, seeming to indicate that climatic conditions are unfavorable here for raising fruit, except in the western mountainous portions. By far the most advantageous climatic influences are deficiencies in temperature and excess of precipitation during April and May. If the ground during these months is cold and wet, germination and growth are delayed, and become slow and irregular, the difficulty of securing good stands is increased, and notwithstanding occasional remarkable recuperative power of vegetation, as shown for example, in July and August, 1895, the final results following any wet, cold April or May will be unsatisfactory. During the remainder of such years crops seem to be especially susceptible to unfavorable influences. April and May of both 1895 and 1897 were very unfortunate, and May, 1891, particularly so, with frost as late as May 8 heavy enough to kill corn and cotton.

In North Carolina the heaviest precipitation usually occurs in July and August. The experience of the past few years seems to show that the average rainfall for the State is in excess of the real requirements of crops. Moisture is important at this time of the year for cotton, which also can not withstand any considerable deficiency in temperature during July. The mean temperature for July, 1891, was the lowest experienced since 1872, and the cotton crop, which had already suffered from cold weather in May was seriously injured, and was practically ruined by subsequent excessive precipitation in August. Excessive precipitation causes rank growth of all crops and delays formation of fruit and its maturity, and also favors the growth of fungus diseases, as was the case notably in 1898.

Departures from normal temperature and precipitation in North Carolina.

(First column, temperature departures; second column, precipitation departures.)

	1889.		1890.		1891.		1892.		1893.	
January	+ 2.9	+0.91	+10.2	−2.94	+1.3	+0.31	−2.2	+1.70	−10.1	−1.44
February	− 4.0	−0.49	+ 8.0	−0.01	+5.1	+1.49	−0.4	−0.86	+ 0.1	+1.20
March	− 0.3	−1.67	− 0.5	−1.16	−3.1	+3.14	−3.4	−1.26	− 1.1	−2.25
April	+ 0.6	−0.14	+ 0.2	−1.02	+1.0	−1.40	−2.2	+0.21	+ 2.1	−1.24
May	+ 1.4	+0.41	+ 0.6	+0.58	−2.8	+1.17	−0.1	−0.64	− 1.8	+1.36
June	− 0.9	+1.54	+ 3.3	−1.54	+0.8	−0.68	+1.2	+2.31	− 1.3	+1.37
July	− 0.5	+2.15	− 1.4	+1.61	−3.4	+1.07	−1.6	+0.15	+ 0.8	−1.57
August	− 2.3	−0.23	− 1.8	+0.58	+0.3	+2.45	+1.4	−1.94	− 1.1	+1.35
September	− 2.0	−0.38	+ 0.8	+0.91	+0.7	−2.31	−1.8	− 0.94	− 0.4	+1.19
October	− 2.3	−1.09	− 0.3	+0.67	−3.5	−1.02	−1.3	−2.98	− 0.2	+1.94
November	+ 2.0	+0.99	+ 2.8	−2.97	−2.7	−0.25	−2.7	+0.34	− 1.4	−0.55
December	+10.3	−3.14	− 1.5	−0.14	+3.3	−1.39	−3.1	−0.92	+ 1.5	−0.60
Year	+ 0.4	−1.14	+ 1.7	−5 38	−0.3	+2.68	−1.4	−4.83	− 1.1	+0.79

	1894.		1895.		1896.		1897.		1898.	
January	+3.4	−0.44	− 1.4	+2.06	−1.6	−1.56	−2.9	−2.05	+4.0	−1.72
February	+0.2	+0.61	−11.5	−1.79	−0.8	+1.43	+1.5	+1.69	−3.6	−3.18
March	+5.8	−2.51	− 0.4	+0.71	−1.3	−1.97	+3.4	+1.00	+5.9	−0.54
April	−1.2	−3.02	− 1.6	−3.58	+3.8	−1.78	−0.9	−0.09	−4.4	−0.07
May	+1.0	−0.21	− 2.8	+0.62	+5.3	+0.07	−2.3	−0.48	+1.6	−0.52
June	+0.1	−1.75	+ 0.2	−0.84	−1.2	+0.99	+0.5	−0.38	+0.5	−0.96
July	−1.4	+0.49	− 1.4	−0.33	−0.2	+2.61	−0.4	+0.02	+0.1	+1.40
August	−1.0	+0.35	+ 0.5	−0.28	+0.9	−3.47	−0.7	−2.37	+1.4	+2.16
September	+1.8	+0.35	+ 3.8	−3.17	−0.1	+0.89	+0.3	−2.95	+1.9	−0.18
October	+0.3	+1.93	− 3.7	−2.56	−2.0	−1 67	+2.7	+0.42	+0.8	+2.85
November	−1.0	−1.90	+ 1.0	−0.17	+5.0	+1.35	+1.5	−0.43	−2.6	−0.08
December	+0.6	−0.20	− 0.2	−0.32	−2.0	−1.22	+1.3	−0.06	−0.5	−0.99
Year	+0.6	−5.30	− 1.6	−1.64	+0.6	−4.33	+0.3	−5.68	+0.4	−1.83

After August adverse conditions, excepting such as result in local loss from heavy rains, floods, or windstorms, have little influence on the ultimate yield of crops. However, early frosts sometimes seriously injure cotton and tobacco. The coldest fall experienced was that of 1892, during which deficiencies in temperature occurred continuously from September to December, with early frost damaging cotton. Both 1896 and 1897 were notable for probably the most severe drought experienced in North Carolina, during the fall, with apparently great deterioration in the condition of crops, yet the final yields were by no means as small as anticipated.

Damage by local storms is comparatively rare. A few instances may he noted: Damage by hail was considerable during May, June, and July, 1891, and in May, 1898. The hurricane of August, 1893, damaged crops throughout the State about 20 per cent by floods and winds.

THE SAN DIEGO WATERSPOUT.

By FORD A. CARPENTER, Weather Bureau.

The weather map on the morning of December 9, 1898, presented the unusual spectacle of an area of high pressure with a crest exceeding 31.1 inches at Denver. Although this high was 600 miles northeast of San Diego, its abnormal intensity was probably responsible for as severe a local storm as this station has ever experienced. The principal feature was a waterspout accompanied by thunder and lightning, which bore a close resemblence to one of the dreaded *chubascos* which rarely occurs north of latitude 18°.

The first instrumental indication was at midnight, when the barometer fell steadily. This was accompanied by a consequent increase in temperature, the thermograph showing an easy upward curve until 2:30 a. m. (local time), when it registered 58°, the maximum for the day. The wind was blowing with gradually increasing velocity from the southeast, south, and southwest, from which last direction a maximum velocity of 23 miles was recorded.

On the evening of December 8, the western sky presented an unusual and beautiful sight. Countless cumulus clouds with well-defined bases, towering tops, and uniform size extended over the southwestern sea as far as the eye could reach. This extravagant display of clouds culminated at 2:30 a. m. in a succession of thunderstorms lasting until nearly sunset. This was the first thunder heard since August 20, 1897. The first shock was unusually loud, rattling the windows and awakening sound sleepers. Rain fell almost immediately to the amount of 0.43, ending at 4.40 a. m. The temperature suddenly dropped 8°, and the barometer rose. The wind shifted to all points of the compass, but with low velocity, settling into a northeast breeze of 20 miles, from which direction a few hours later, it slowly veered to the southeast, attaining a maximum velocity of 35 miles at 9:50 a. m.

It was just before this maximum of 35 miles per hour (the highest velocity of the year), that the waterspout was observed about 8 miles distant a little north of west from the Weather Bureau office, or 2 miles off Point Loma. A gray mass of nimbus cloud overhung the moderate swell of the sea, and from this cloud a convex projection first appeared, rapidly changing its form in an erratic manner, but quickly terminating in a slightly inclined column of whitish vapor. It was about 1,000 feet in height and probably averaged one-tenth that amount in diameter. The location and dimensions of the waterspout were ascertained by considering the observations of several persons located at different elevations and portions of the city, and taking into consideration the known height of the promontory of Point Loma.

For ten minutes this sheath of condensed vapor moved in a northeasterly direction toward the shore with a velocity of about 20 miles an hour, when it apparently dissolved into the black mass of nimbus cloud which, throughout the existence of the waterspout, had served for a background. Shortly after it disappeared, rain fell in torrents on the low hills closely skirting the shore line. At La Jolla, 12 miles north of this station, 3 inches of rain fell in a few hours. The recently plowed grainfields in this locality looked as if tanks of water had been emptied in various spots. Several culverts on the railroads near this place were washed away.

During the night the fishing fleet put into the harbor, and as the other coastwise craft were detained by the gale, the

waterspout was not observed by anyone in its immediate vicinity. This was probably fortunate for the sailors, although a closer observation of this phenomenon would have been highly interesting, as it is believed to be the first time a waterspout has been observed on this coast so far north as San Diego.

THE WEATHER AND STORMS OF MALTA DURING OCTOBER, 1898.

By JOHN H. GROUT, JR., United States Consul at Valetta, Malta.

The month of October, 1898, will long be remembered by the residents of the Maltese Islands on account of its unusually severe storms and rainfall. The rainfall alone from the first to the middle of the month has been more than has been recorded for a like period for a great many years. At the time of the beginning of the usual fall rains, moisture was badly needed by the growing crops. The amount that has this year fallen has been so extensive in quantity as to very seriously injure the crops and add to the prevailing hard times. The soil of Malta is very light in depth, and the overabundance of rain which has recently fallen has proved a disaster instead of a blessing.

On October 1, in the forenoon, a cyclone swept the islands. With it came a great quantity of rain and the result was that everything was flooded. To this was added much destruction by the exceedingly high gale. The storm lasted about three hours.

On October 19, these islands were visited by a severe hailstorm which, it is said here, has never been equalled at Malta.

The stones were indeed of an abnormal size, in many cases larger than a good-sized duck egg, and in some places larger than an orange, several of half a pound were weighed, three in a pound were numerous, and they came down with terrific force, smashing glass and everything breakable right and left, amidst deafening noise. Such a heavy downfall is unprecedented, and the oldest inhabitant can not remember the like of it. Fortunately, the cloud-burst did not last long, otherwise there would have been the danger of roofs giving way under the weight of the ice, which would have accumulated on the terraces.

The storm came indeed as a surprise. A sultry southwest wind had been blowing for some days, and in the morning a breeze from the northwest set in. The weather was fine until about 1 p. m., when banks of clouds appeared in the northwest. But no signs were visible of what was impending. The wind suddenly rose, and shortly after, the storm broke out like a thunderbolt from the blue, just as did the tornado of the 1st instant.

Hail falls nearly every season in Malta, but its size is very diminutive, seldom being greater that one-fourth of an inch in diameter, at times it is a little larger, but the hailstone is practically unknown.

All during this week the *sirocco* has been blowing with an amazing perseverance, but the day before yesterday at 1:20 p. m. the premonitory signs of a storm were seen on the western horizon. Dark, low, heavy clouds began to gather little by little, distant thunder was heard and lightning seen in the skies; these were soon covered over by dark clouds; at 1:45 the *irpar*, as it is called in Maltese, was in full action. The wind veered to the west, it kept on rising higher, clouds of dust were driven before it, and at 2 p. m. the storm was at its maximum. All this time, a distant rumbling noise was heard, everybody was wondering what was the cause of it, but its explanation was soon forthcoming. Hail began to fall and kept coming down for over five minutes.

[NOTE.—We perceive that the local English newspapers as well as the manuscript of our consul speak of the storm of October 1 as a cyclone, a gale, a cloud-burst, a tornado, whereas the storm of the 19th was simply a hailstorm or the Maltese *irpar*. It is not certain that the popular nomenclature in Malta and England is any better than that in the United States.—ED.]

THE AVERAGE FREQUENCY OF DAYS OF HAIL DURING 1893–1897.

By Miss ALICIA DE RIEMER and C. ABBE.

The records published regularly in the MONTHLY WEATHER REVIEW show the number of days in each month on which hail fell at one or more stations in each State. Thus, in Alabama it fell on six days in April, 1893; twice in April, 1894, and three times in April, 1895, 1896, and 1897, respectively, or on the average 3.4 days annually. The following lines give a summary of this published data for the five years. 1893–1897. The relative frequency of hailstorms must be computed from this data by different methods according as we desire to ascertain the relative frequency per month in any one State, or the relative frequency during any month in the different States.

TABLE 1.—*Total absolute frequency of hailstorms during* 1893–1897.

States.	Areas in units of 10,000 square miles.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual. State.	Annual. Unit area.
Alabama	5.1	6	6	17	17	16	13	4	7	4	1	3	4	98	19.3
Arizona	11.4	5	9	9	8	7	6	13	19	16	15	4	2	113	9.9
Arkansas	5.2	4	12	19	37	16	16	6	8	4	4	4	2	132	25.4
California	15.8	22	19	45	36	21	4	8	5	8	9	10	14	201	12.7
Colorado	10.4	0	1	11	18	41	69	60	63	24	19	1	0	307	29.6
Connecticut	0.5	0	3	3	12	1	12	11	6	4	0	2	0	54	108.
Delaware	0.2	0	0	2	3	5	2	2	2	1	0	1	1	19	95.
Dist. of Columbia.	0.01	0	0	1	2	3	1	0	0	0	0	0	0	7	700.
Florida	5.9	3	8	5	13	18	7	3	2	1	0	0	0	60	10.5
Georgia	5.8	2	4	13	21	22	13	10	4	2	2	2	3	98	16.9
Idaho	8.1	0	1	8	38	42	34	13	14	12	9	1	0	172	21.3
Illinois	5.5	2	3	22	47	39	41	25	18	21	11	1	2	232	42.2
Indiana	3.4	1	1	18	34	40	29	18	15	7	1	2	1	167	49.2
Indian Territory.	3.1	1	3	12	10	5	1	0	0	1	2	4	0	39	12.9
Iowa	5.5	2	0	15	42	43	42	34	27	17	6	3	1	232	42.2
Kansas	8.1	1	3	19	57	51	61	22	9	20	9	1	1	254	31.4
Kentucky	3.8	1	4	14	25	23	21	19	22	3	4	0	0	136	35.8
Louisiana	4.1	5	14	21	19	14	7	6	2	0	5	7	3	103	25.2
Maine	3.5	0	0	1	1	7	8	4	2	4	5	0	0	32	9.2
Maryland	1.1	1	0	5	8	17	12	23	16	6	5	4	0	97	88.2
Massachusetts	0.8	0	0	3	14	16	13	20	13	6	5	1	0	81	102.
Michigan	5.6	1	0	10	20	38	26	12	27	13	11	0	0	158	28.3
Minnesota	8.4	0	0	5	29	34	46	27	35	10	2	0	0	188	22.4
Mississippi	4.7	4	13	28	22	16	12	3	2	1	1	2	4	108	23.1
Missouri	6.5	7	7	30	66	47	51	24	18	16	11	4	4	285	43.9
Montana	14.4	0	0	2	8	23	35	29	17	8	6	0	0	128	8.9
Nebraska	7.6	0	0	9	46	33	55	31	29	10	0	3	3	219	28.9
Nevada	11.2	2	0	8	21	26	20	21	12	14	15	7	0	146	13.1
New Hampshire	0.9	0	0	1	5	6	12	9	5	3	6	1	0	48	53.4
New Jersey	0.8	0	0	5	9	12	16	14	12	10	3	8	0	89	112.
New Mexico	12.1	1	2	5	4	19	31	17	20	8	8	3	2	120	9.9
New York	4.7	0	0	8	26	17	23	22	20	16	13	3	0	148	31.5
North Carolina	5.1	2	4	11	18	36	26	16	8	6	3	1	2	133	26.1
North Dakota	7.5	0	0	1	17	31	28	26	21	14	4	1	0	143	19.1
Ohio	4.0	0	1	16	41	45	36	25	21	12	14	3	1	215	53.7
Oklahoma	3.9	0	3	3	28	19	10	3	1	2	2	2	0	73	18.7
Oregon	9.5	7	21	33	33	35	19	10	4	12	6	14	10	204	21.5
Pennsylvania	4.6	0	1	5	19	27	22	27	20	11	5	4	1	142	30.9
Rhode Island	0.1	0	0	0	2	0	0	3	1	2	0	1	1	10	100.
South Carolina	3.4	4	9	3	13	20	21	3	16	0	4	1	3	97	28.6
South Dakota	7.6	0	0	4	20	18	46	39	17	7	2	1	0	154	20.3
Tennessee	4.6	2	3	25	30	22	18	11	8	6	2	3	2	131	28.5
Texas	27.4	8	10	34	45	37	22	8	8	5	7	8	6	198	7.2
Utah	8.4	1	3	5	18	21	22	18	15	12	11	1	1	128	15.3
Vermont	1.0	0	0	1	5	3	7	4	9	2	1	0	0	32	32.
Virginia	6.1	1	2	7	15	29	16	14	10	5	1	2	0	102	16.8
Washington	7.0	1	12	32	47	22	11	2	2	13	17	8	7	174	24.8
West Virginia	2.3	0	1	4	21	22	15	9	4	4	7	3	1	91	39.7
Wisconsin	5.8	0	2	7	37	40	33	21	16	12	7	1	0	166	31.4
Wyoming	9.8	0	0	1	9	3	18	12	9	4	0	0	0	56	5.8

In the latter case, we must divide the monthly averages by the area of the State in order to eliminate the inequality depending on the size of the State. Table 1 shows, 1st, the area of each State, expressed in units of 10,000 square miles; 2d, the total number of dates on which hail fell during the five years, both for each month and for the year. Finally, in the last column, the proportionate total number of hail days for one unit of area. The States in which hail-falls per unit area have been most frequent are the small States, viz, Connecticut, 108; District of Columbia, 700; Maryland, 88; Massachusetts, 102; New Hampshire, 53; New Jersey, 112; Ohio, 54; Rhode Island, 100. But these large numbers result from the smallness of the divisors, and omitting these States from consideration, we find the greatest frequency of hail in